

ABSTRACT

A method and apparatus satisfying growing demands for improving the precision of angle of incidence of implanting ions that impact a semiconductor wafer and the precision of ribbon ion beams for uniform doping of wafers as they pass under an ion beam. The method and apparatus are directed to the design and combination together of novel magnetic ion-optical transport elements for implantation purposes. The design of the optical elements makes possible: (1) Broad-range adjustment of the width of a ribbon beam at the work piece; (2) Correction of inaccuracies in the intensity distribution across the width of a ribbon beam; (3) Independent steering about both X and Y axes; (4) Angle of incidence correction at the work piece; and (5) Approximate compensation for the beam expansion effects arising from space charge. In a practical situation, combinations of the elements allow ribbon beam expansion between source and work piece to 350 millimeter, with good uniformity and angular accuracy. Also, the method and apparatus may be used for introducing quadrupole fields along a beam line.